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## ARTICLE

# Hypertension knowledge, heart healthy lifestyle practices and medication adherence among adults with hypertension

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## Abstract

**Objective:** To assess patients' knowledge about hypertension and its association with heart healthy lifestyle practices and medication adherence.

**Methods:** We conducted a cross sectional survey of 385 adults with hypertension treated at 2 primary care clinics in Baltimore, Maryland, USA. We used an 11-item measure to assess hypertension knowledge and obtained self-reports on dietary changes, engagement in aerobic exercise and medication adherence.

**Results:** Approximately 85% of patients properly identified high blood pressure, but more than two-thirds were unaware that hypertension lasts a lifetime once diagnosed; one-third were unaware that hypertension could lead to renal disease. Patients with low hypertension knowledge were less likely to reduce their salt intake (OR=0.44 [95% CI: 0.24-0.72]) and eat less to lose weight (OR=0.48 [95% CI: 0.26-0.87]) than patients with high hypertension knowledge.

**Conclusion:** In general, patients were knowledgeable about hypertension, but most were unaware that hypertension is a lifelong condition and could lead to kidney disease. High knowledge of hypertension was associated with healthy lifestyle practices including eating less to lose weight and dietary salt reduction.

**Practice Implications:** Intensifying education strategies to improve patients' knowledge of hypertension may enhance their engagement in heart healthy lifestyle practices for optimal blood pressure control.

## Keywords

Blood pressure control, heart healthy lifestyle practices, hypertension knowledge, lifestyle modification, medication adherence, patient awareness, patient counseling, patient education, person-centered healthcare

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## Introduction

Hypertension is a major modifiable cause of cardiovascular disease which affects more than one billion individuals worldwide [1,2]. Due to its asymptomatic and persistent nature, hypertension is referred to as "the silent killer" [3]. In the United States, hypertension affects approximately 1 in 3 adults despite considerable improvements in the detection and management of high blood pressure over time [4,5]. Several decades ago, less than one quarter of American adults were aware that hypertension could result

in stroke and heart disease [4]. Approximately one half of adults with hypertension were aware they had high blood pressure and only 10% of those treated had good blood pressure (BP) control [4]. In more recent surveys, more than three quarters of American adults were aware that stroke and heart disease are complications of hypertension, over 70% knew they had high BP and more than one half of those treated for hypertension achieved optimal BP control [4,5].

The reasons for uncontrolled hypertension are multifactorial with a number of patient and provider

contributory factors [6]. Insufficient knowledge about hypertension could lead to less optimal BP control through lower rates of adherence to prescribed antihypertensive medications and engagement in heart healthy lifestyle practices which have been shown to promote adequate BP control and prevent complications resulting from high BP [7,8,9]. Clinical trials have consistently reported that reduction in the dietary intake of sodium favorably affects BP control among older adults [10,11]. Furthermore, observational studies and randomized trials have shown that weight loss lowers BP in hypertensive individuals, as does increasing levels of regular physical activity [12,13]. Adherence to recommended antihypertensive medications is central to adequate hypertension control resulting in reduced cardiovascular morbidity and mortality and lower healthcare costs [14,15].

A previous study showed that patients have good knowledge that lowering their BP will improve their health status [16]. However, among the limited number of studies that have evaluated patient's knowledge about hypertension; most failed to explore the relationship between hypertension knowledge and the adoption of heart healthy lifestyle practices and adherence to antihypertensive medications. The purpose of the cross sectional study presented here was to examine the extent of knowledge about hypertension among adult hypertensive patients and the association between hypertension knowledge and engagement in heart healthy lifestyle practices and antihypertensive medication adherence for more effective BP control.

## Methods

### Study design and participants

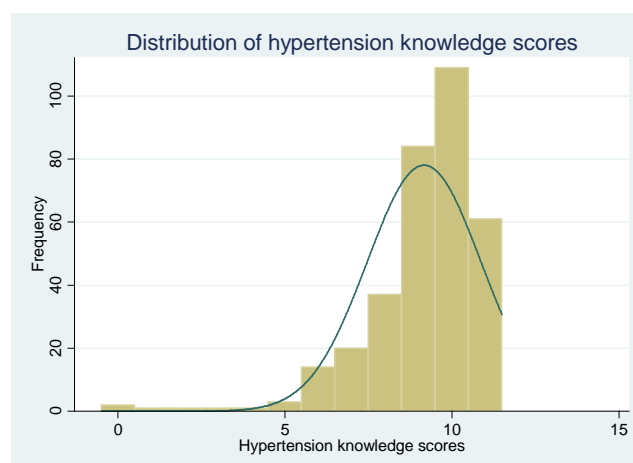
A cross-sectional self-administered survey was conducted in 2012 at 2 primary care clinics in Baltimore, MD. This survey was used to obtain baseline data for a quality improvement pragmatic trial (Project ReD CHiP; 2010-2015) designed to address multilevel factors known to contribute to disparities in the management of adults with hypertension. The recruitment methods and interventions used in this pragmatic trial have been described in detail previously [17]. In brief, consent was obtained by an introductory statement on the survey instrument informing participants that by responding to the survey they were participating in a research study. The eligibility criteria included adult patients  $\geq 18$  years of age, who had been diagnosed with hypertension and had been seen by a primary care provider in the prior 6 months. The Johns Hopkins Medicine Institutional Review Board approved this observational study.

### Measurement of Hypertension Knowledge

Hypertension knowledge was assessed using questions adapted from a 21 item questionnaire on individuals' knowledge of hypertension [18]. The questionnaire was

developed to ascertain knowledge about hypertension in a population of patients with low literacy [18]. Since our study was designed to address other aims in addition to patients' knowledge about hypertension, to reduce participant burden we adapted a shorter version with 11 questions about the definition, prevention, management and complications of hypertension. Patient responses were recorded as either "true", "false" or "uncertain", from which we created binary codes of "correct" for true responses or "incorrect" for false and uncertain responses. One point was allocated to each question and we generated summary scores ranging from 0-11. Based on the distribution of knowledge scores (Figure 1), we chose cut-off values for hypertension knowledge; patients with scores  $< 9$  were classified as having low knowledge whereas patients with scores  $\geq 9$  were classified as having high knowledge. Internal reliability of the knowledge scores using Cronbach's alpha was 0.7 indicating adequate internal consistency [19].

Figure 1 Distribution of hypertension knowledge scores from the 11-item measure



### Outcome variables

Patient engagement in heart healthy lifestyle modification practices was assessed from patient self-reports which included questions about; reduction in the amount of dietary salt consumed, eating less to lose weight and engagement in weekly aerobic exercises. Patients were asked about their salt consumption and dietary changes with the following statements "I reduce my salt intake as much as possible" and "I eat less to help me lose weight" with responses of "Disagree Strongly", "Disagree", "Neutral", "Agree" or "Agree Strongly". We created binary responses from the questions on dietary salt intake and eating less to lose weight as follows; Agree and Agree strongly were coded as "Yes" and the other responses as "No". Patients were asked about their engagement in aerobic exercise with the question: "Do you engage in any regular exercise such as brisk walking, jogging or bicycling." The responses were "No", "Yes, 1-2 times per week" or "Yes, 3 times a week or more". We created a

binary response of “No” for those who responded “No” and “Yes” for all other responses.

Medication adherence was assessed with a 4-item medication adherence questionnaire based on its simplicity, availability and validation in a previous study [20]. Patients were asked questions about their antihypertensive medication-taking behaviors with binary responses of “yes” or “no”: (1) “Do you ever forget to take your blood pressure medicine?”, (2) “Are you careless about taking your blood pressure medicine?”, (3) “When you feel better do you sometimes stop taking your blood pressure medicine?” and (4) “If you feel worse when you take your blood pressure medicine do you sometimes stop taking it?” We dichotomized patient responses as “adherent” if they responded “No” to all 4 questions and “non-adherent” if they responded “Yes” to at least one question [20].

## Covariates

Patient demographic characteristics included age, sex, race, highest level of education attained and annual household income. We categorized the highest level of education as < high school degree or ≥ high school degree. Annual household income was categorized as < \$50,000 and ≥ \$50,000. Patient’s health literacy was assessed with the question: “How confident are you filling out medical forms by yourself?” Consistent with prior health literacy studies, we categorized health literacy as adequate if the participants answered “quite a bit confident” and “extremely confident” or as inadequate if they answered “not at all confident”, “a little confident” and “somewhat confident” [21]. These variables were adjusted for in the multivariable models based on prior reports of their association with knowledge about hypertension and patient’s adoption of heart healthy lifestyle behaviors and medication adherence [8,16,18].

## Data Analysis

We analyzed data from a total of 313 study participants who did not have missing values for the knowledge questions and other covariates. We compared differences in various patient characteristics for those with low *versus* high hypertension knowledge scores, using chi-square analysis for binary variables and student’s t-test for continuous variables. In examining the association between the level of hypertension knowledge and engagement in lifestyle modification practices, we conducted several univariable and multivariable logistic regression models for each outcome (dietary salt intake, eat less to lose weight, engagement in weekly aerobic exercise and antihypertensive medication adherence). Multicollinearity was evaluated and ruled out by using a variance inflation factor of 3 or more to detect correlations between the covariates included in the models. All analyses were done using STATA 13 (StataCorp, College Station, Texas).

Model results are shown as odds ratios (OR) and accompanying 95% Confidence Intervals (CIs)

## Results

### Characteristics of study participants

Overall, the mean age of study participants was 59.5 years, 72.5% were women and more than one-half were Black. The majority had greater than a high school education and approximately three quarters had adequate health literacy. The average age of patients with low and high knowledge of hypertension was relatively similar (Table 1). Approximately two-thirds of patients with low knowledge of hypertension had adequate health literacy whereas 77% of patients with high knowledge of hypertension had adequate health literacy.

### Hypertension knowledge

More than 80% of respondents correctly specified high blood pressure as readings ≥ 140/90mmHg and knew that hypertension is asymptomatic (Table 2). Approximately 90% of patients were aware of the complications associated with hypertension including stroke, heart attack and heart failure. However, one third of participants did not know that hypertension could cause kidney disease. More than two-thirds of the patients were unaware that hypertension “usually lasts for a lifetime” once diagnosed. At least 90% of participants correctly answered the questions about the role of heart healthy lifestyle modifications in lowering BP including dietary salt reduction, consumption of fruits and vegetables, exercising regularly and losing weight. Figure 1 shows the distribution of hypertension knowledge scores ranging from 0-11 with an asymmetric distribution and left skewness. Approximately 1 in 5 patients had low hypertension knowledge scores (< 9).

### Engagement in heart healthy lifestyle practices and antihypertensive medication adherence

Over half of the study participants were engaged in heart healthy lifestyle practices; 65% reported adherence to their antihypertensive medications, 75% reduced salt in their diet and approximately one half engaged in regular aerobic exercise and ate less portions to lose weight. After accounting for the potential confounding effects of patients’ sociodemographic characteristics and health literacy, persons with a high level of knowledge about hypertension were significantly more likely to reduce salt in their diet and eat less to lose weight than patients with low hypertension knowledge (Table 3). Although not statistically significant, we found that patients with low knowledge of hypertension had a lower odds of being

Table 1 Characteristics of Study Participants according to hypertension knowledge scores (n= 313)

Characteristics	Participants with low knowledge* (n=64)	Participants with high knowledge* (n=249)	P-value
Sociodemographic characteristics, n (%)			
Age mean, yrs. (SD)	58.5 (11.7)	59.8 (13)	0.49
Female	46 (71.9)	181 (72.7)	0.9
Black	31 (48.4)	139 (57.8)	0.18
>High school Education	60 (95.2)	216 (90.1)	0.21
Annual Income ≥\$50,000	32 (50)	153 (61.4)	0.1
Adequate health literacy	41 (64.1)	192 (77.1)	0.03

\*Low hypertension knowledge (score <9); High hypertension knowledge (score ≥ 9)

Table 2 Frequency of correct responses to hypertension knowledge measure (definition, prevention, complications and management)

11 item Hypertension knowledge measure		Correct (n)	% Correct
1.	A blood pressure reading of 140 over 90 or higher is considered high blood pressure.	263	85.1
2.	High blood pressure is especially dangerous because it often has no warning signs or symptoms.	278	88.8
3.	High blood pressure can cause heart failure.	267	89.3
4.	Once high blood pressure develops, it usually lasts a lifetime.	106	33.9
5.	High blood pressure can cause kidney disease.	199	64.2
6.	High blood pressure can lead to stroke.	297	96.1
7.	High blood pressure can lead to heart attack.	292	94.2
8.	A person who has high blood pressure should eat less salt.	294	94.8
9.	A person who has high blood pressure should eat more fruits and vegetables.	286	92.3
10.	Exercise can lower a person's blood pressure.	282	90.1
11.	Losing weight can lower a person's blood pressure.	300	95.8

Table 3 Prevalence of self-management practices according to hypertension knowledge and association between hypertension knowledge and self-management practices

Outcome variables	Self-management prevalence among patients with low knowledge (n=64)	Self-management prevalence among patients with high knowledge (n=249)	Low vs. High Knowledge Unadjusted OR (95% CI)	Low vs. High Knowledge *Adjusted OR (95% CI)
Reduce dietary salt	60.9%	78.3%	0.43 (0.24-0.77)	0.44 (0.25-0.86)
Eat less to lose weight	37.5%	54.2%	0.51 (0.29-0.89)	0.48 (0.29-0.96)
Weekly Exercises	57.8%	55.4%	1.1 (0.63-1.92)	1.31 (0.74-2.38)
Medication Adherence	60.9%	65.9%	0.81 (0.46-1.42)	0.8 (0.45-1.5)

\*Each model was controlled for participant's age, sex, race, education, annual income and health literacy.

adherent to their antihypertensive medication and a higher odds of engaging in regular aerobic exercise than patients with adequate hypertension knowledge. (Table 3).

## Discussion

In this population of adults with hypertension who attended two primary care clinics in the city of Baltimore, we found that patients were very knowledgeable about some aspects of their condition, but the majority were unaware that hypertension is a lifelong condition and that high BP could lead to kidney disease. Overall, more than

one half of the patients adopted recommended self-management practices for hypertension. Patients with low knowledge about hypertension were less likely to be engaged in heart healthy lifestyle practices compared to patients with high knowledge about hypertension.

The majority of our survey respondents could correctly identify that BP levels  $\geq 140/90$ mmHg are defined as high and were aware of the asymptomatic nature of hypertension, as well as the complications due to high BP including stroke and heart attack. Our results are consistent with the findings from a geographically and ethnically diverse cross sectional study which assessed the extent of knowledge about hypertension among 530 patients attending 24 primary care practices throughout North Carolina. This study found that 86% of respondents correctly identified high BP readings as values  $\geq 140/90$ mmHg and the vast majority of patients were aware that high BP can be life threatening [22]. The finding that most patients have good general knowledge about hypertension emphasizes the increases in the general public's awareness of high BP through increased educational efforts and public campaigns over the past several decades in the United States by major voluntary organizations and the National Institutes of Health [4]. Worldwide, improvements in hypertension awareness are not widespread and recent observational studies report a low level of knowledge about the definition, treatment and complications of hypertension among hypertensive patients in developing countries [23,24].

In the present study, we identified two major gaps in patient knowledge about hypertension. One third of study participants were unaware that renal disease is a complication of hypertension and two-thirds did not know that hypertension lasts a lifetime once diagnosed. Similarly, a cross sectional telephonic survey which assessed knowledge of hypertension among adults diagnosed with high BP reported that more than one quarter of patients were unaware that a diagnosis of hypertension lasts for a lifetime and that renal failure is a complication of hypertension [25]. In the United States, uncontrolled high BP has not only been linked with the development of chronic kidney disease, but has been identified as the second leading cause of end-stage renal disease after diabetes mellitus [26]. These results should encourage physicians to emphasize the chronic nature of hypertension to patients during regularly scheduled clinic visits and the possibility of renal complications resulting from uncontrolled hypertension. Patients who do not understand the persistent nature of hypertension or the consequences of uncontrolled high BP may be less likely to adhere to long term antihypertensive medication and sustain various heart healthy lifestyle practices that have been shown to lower BP. In addition, patients may hold certain beliefs about being cured from their illness despite being informed that hypertension lasts a lifetime. To address this problem, it may be necessary to increase public education beyond the clinic setting about the persistent and asymptomatic nature of hypertension.

We found that patients with low hypertension knowledge were less likely to reduce salt in their diet and eat less to lose weight compared with patients who had

high knowledge about hypertension. Our findings are consistent with a cross sectional study conducted in Ethiopia that examined factors associated with adherence to recommended lifestyle modification practices among 404 patients managed for hypertension. The results of this study showed that knowledge about hypertension was an independent predictor of adherence with heart healthy lifestyle practices including dietary changes, smoking and alcohol consumption [27]. Although our study showed trends between patients' knowledge of hypertension and antihypertensive medication adherence, prior studies have shown significantly better adherence among patients who were more knowledgeable about their condition [23,27]. In addition to insufficient knowledge of hypertension, other factors that may cause low medication adherence including pill burden and costs of medication [28], were not accounted for in this present study. Although the majority of our study participants were knowledgeable about the lifestyle modifications required for optimal BP control, we recognize that patient knowledge may not necessarily translate into actions due to low self-efficacy, cultural dietary practices, social support and other external factors [27]. Effective patient-provider communication is crucial for identifying the potential reasons why patients may not adopt recommended lifestyle practices and in providing person-centered counseling sessions tailored to the individual patient's needs.

To our knowledge, this is the first observational study to examine the association between hypertension knowledge and engagement in various heart healthy lifestyle modification practices and adherence to antihypertensive medication. We used adapted questions from a validated measure to assess patient knowledge about hypertension and had good internal reliability of the questions. However, our study has several potential limitations that need to be considered. First, since we collected information on heart healthy lifestyle practices through patient self-reports, this could have resulted in recall bias and social desirability bias. Second, there is a possibility of selection bias since we included patients who had seen their primary care physician within six months of completing our survey and these patients may be more knowledgeable about their condition. The hypertension knowledge questionnaire was originally used for a population with low literacy compared to our study population in which the majority of respondents had more than a high school degree. Although we examined a number of potential explanatory factors which may influence the association between hypertension knowledge and adoption of heart healthy lifestyle practices and antihypertensive medication adherence, we acknowledge that there may be unmeasured confounders not accounted for in our study including patient motivation, cultural dietary practices, access to healthy food sources and physical activity resources and opportunities.

## Conclusion

We found that patients diagnosed with high BP have adequate knowledge on some aspects of their chronic condition. However, important gaps exist in patients' knowledge of hypertension including the "life-long nature" of this condition and potential renal complications. Patients with low knowledge about hypertension were less likely to change their dietary practices such as eating less to lose weight and reducing the amount of dietary salt consumed. Future educational intervention studies to improve patients' knowledge are recommended, as are studies which would assess longitudinal associations between knowledge of high BP and long-term adherence to hypertension management and lifestyle practices.

The results of our study have clinical implications for patient management, given our identification of important gaps in patients' knowledge about hypertension. We recommend that educational programs be tailored to the needs of patients with hypertension and that provider communication skills training programs should target education and counseling skills in order to promote increased awareness of the chronic nature of hypertension. We suggest that physicians can use open-ended questions to assess patients' knowledge of hypertension as well as the teach-back method to ascertain how well patients understand the education messages provided by physicians.

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